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Docket No.: 2328-062

PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

DHINDSA, Rajinder *et al.*

Confirmation No. 8414

U.S. Patent Application No. 10/645,665

Group Art Unit: 2821

Filed: August 22, 2003

Examiner: Tung X Le

For: MULTIPLE FREQUENCY PLASMA ETCH REACTOR

DECLARATION UNDER 37 CFR 1.131

We, Rajinder Dhindsa, Eric Lenz, Mukund Srinivasan, Aaron Eppler, Lumin Li, Felix Kozakevich, Camelia Rusu, Dave Trussel, Reza Sadjadi, Jim Tietz, and Jeff Marks, the applicants of the referenced application hereby declare as follows:

1. Prior to August 1, 2003, we successfully reduced to practice a vacuum plasma processor comprising a vacuum chamber having a (a) lower electrode including an electrostatic chuck (ESC) that carried a workpiece in the form of a semiconductor wafer and (b) an upper electrode, wherein a frequency of 40 MHz was applied to the upper electrode and frequencies of 27 MHz and 2 MHz were applied to the bottom electrode. Exhibit 1 is a cross-sectional view of the vacuum chamber that was operated under these conditions. The vacuum chamber illustrated in Exhibit 1 was modified so that (a) 47 MHz (instead of 27 MHz) was applied to the upper electrode at the same time that (b) 27 MHz and 2 MHz (instead of 2 MHz) were applied to the 200 mm electrostatic chuck (ESC) included in the bottom electrode.

2. Exhibits 2 and 3 are microphotographs of three different semiconductor wafers that were successfully etched prior to August 1, 2003 with the arrangement described in Paragraph 1, wherein the upper and lower electrodes are respectively indicated in Exhibits 2 and 3 by UE and LE. The microphotographs of Exhibits 2 and 3 include dates that are prior to August 1, 2003, but have been redacted.

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**Application No.: 10/645,665****Docket No.: 2328-062**

3. For the left microphotographs of Exhibits 2 and 3, 900 W at 40 MHz was applied to the upper electrode, while 300 W at 27 MHz and 1800 W at 2 MHz were applied to the lower electrode. For the center microphotographs of Exhibits 2 and 3, 600 W at 40 MHz was applied to the upper electrode, while 600 W at 27 MHz and 1800 W at 2 MHz were applied to the bottom electrode. For the right and microphotographs of Exhibits 2 and 3, 300 W at 40 MHz was applied to the upper electrode, while 900 W at 27 MHz and 1800 watts at 2 MHz were applied to the bottom the electrode. In all instances, the vacuum chamber was operated at a vacuum pressure of 50 millitorr and the etchant, i.e., processing, gas was a mixture of argon, C4F8 and oxygen.

4. The microphotographs of Exhibits 2 and 3 include clear indications of holes that were successfully bored into the semiconductor wafers and that the holes bored in the different wafers had different characteristics for the different powers that were applied to the different frequencies.

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, or imprisonment, or both, under

Application No.: 10/645,665Docket No.: 2328-062

Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DATED this \_\_\_\_\_ day of September, 2007, at \_\_\_\_\_.

  
Rajinder Dhindsa,  
Eric Lenz  
Mukund Srinivasan,  
Aaron Eppler  
Lumin Li,  
Felix Kozakevich  
Camella Rusu  
Dave Trussell  
Reza Sadjadi,  
Jim Tietz  
Jeff Marks

## CERTIFICATION OF FACSIMILE TRANSMISSION

I HEREBY CERTIFY THAT THIS PAPER IS BEING FACSIMILE TRANSMITTED TO THE PATENT AND TRADEMARK OFFICE

ON THE DATE SHOWN BELOW

CHRISTINA FRYE

TYPE OR PRINT NAME OF PERSON SIGNING CERTIFICATION

  
SIGNATURE

DATE

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James V. Tietz

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Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DATED this 8<sup>th</sup> day of November ~~September~~, 2007, at 11:45A.

Rajinder Dhiridsa,

Eric Lenz

Mukund Srinivasan,

Aaron Eppler

Lumln Li,

Felix Kozakevich

Camelia Rusu

Dave Trussel

Reza Sadjadi,

James V. ~~James V. Tietz~~

Jeff Marks

CERTIFICATION OF FACSIMILE TRANSMISSION  
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LE TRANSMITTED TO THE PATENT AND TRADEMARK OFFICE  
ON THE DATE SHOWN BELOW

CHRISTINA FRYE

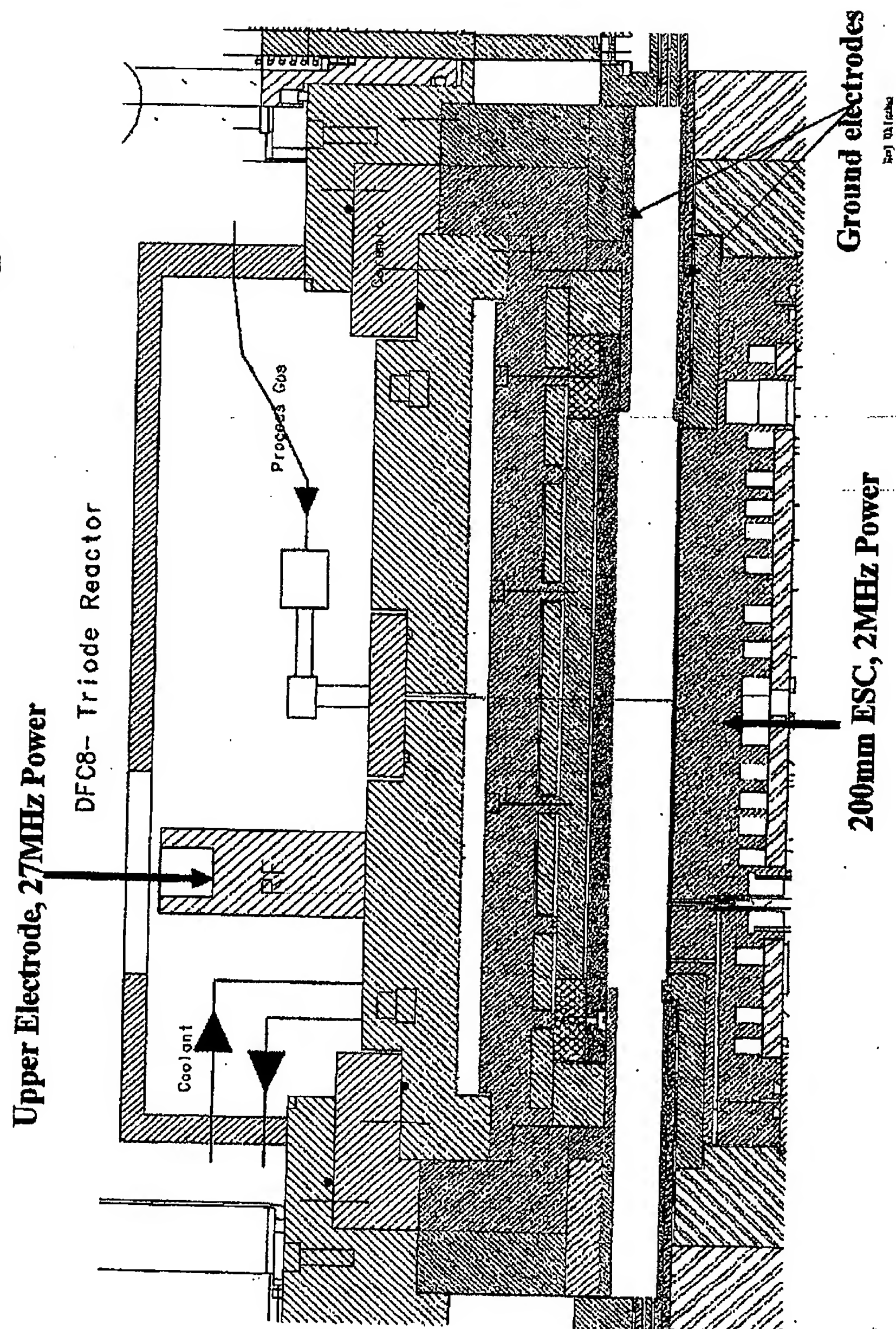
TYPE OR PRINT NAME OF PERSON SIGNING CERTIFICATION

Christina Frye 11/21/07  
SIGNATURE DATE

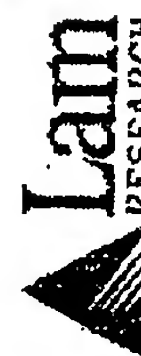
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# DFC 8: Triode Split Power Configuration



Area ratio ~ 2.0. 27Mhz from top electrode, 2 Mhz from bottom electrode. Ground is outside upper electrode OD and at lower ground ring.



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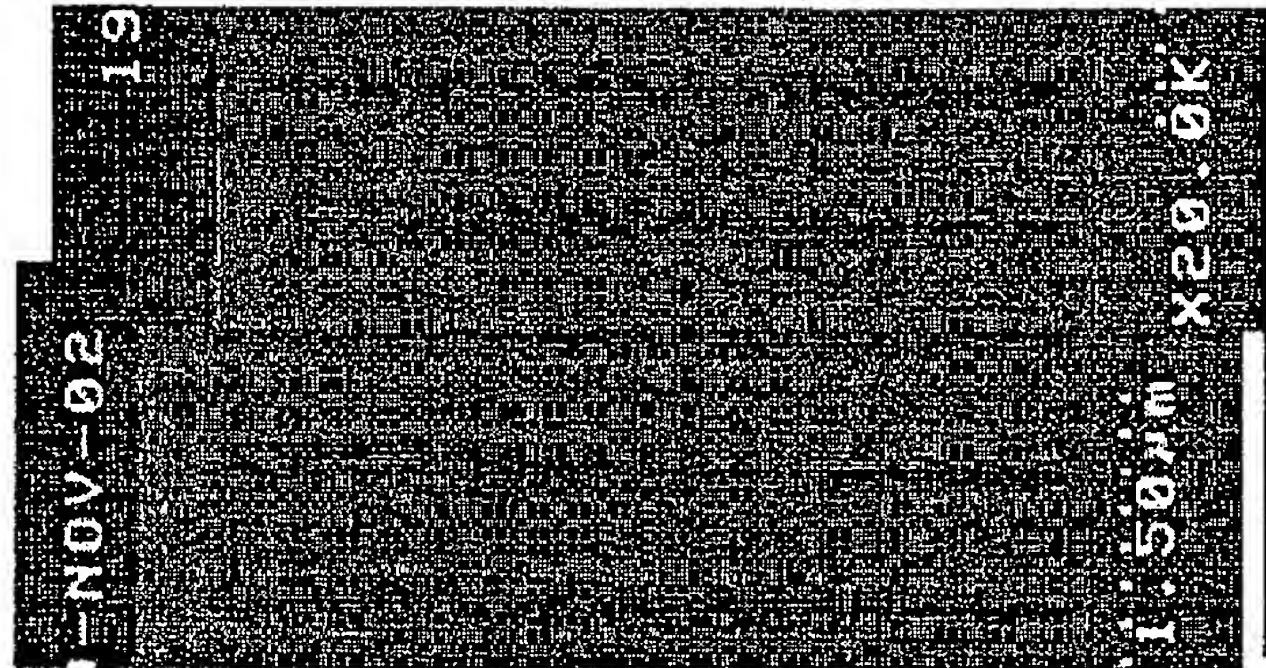
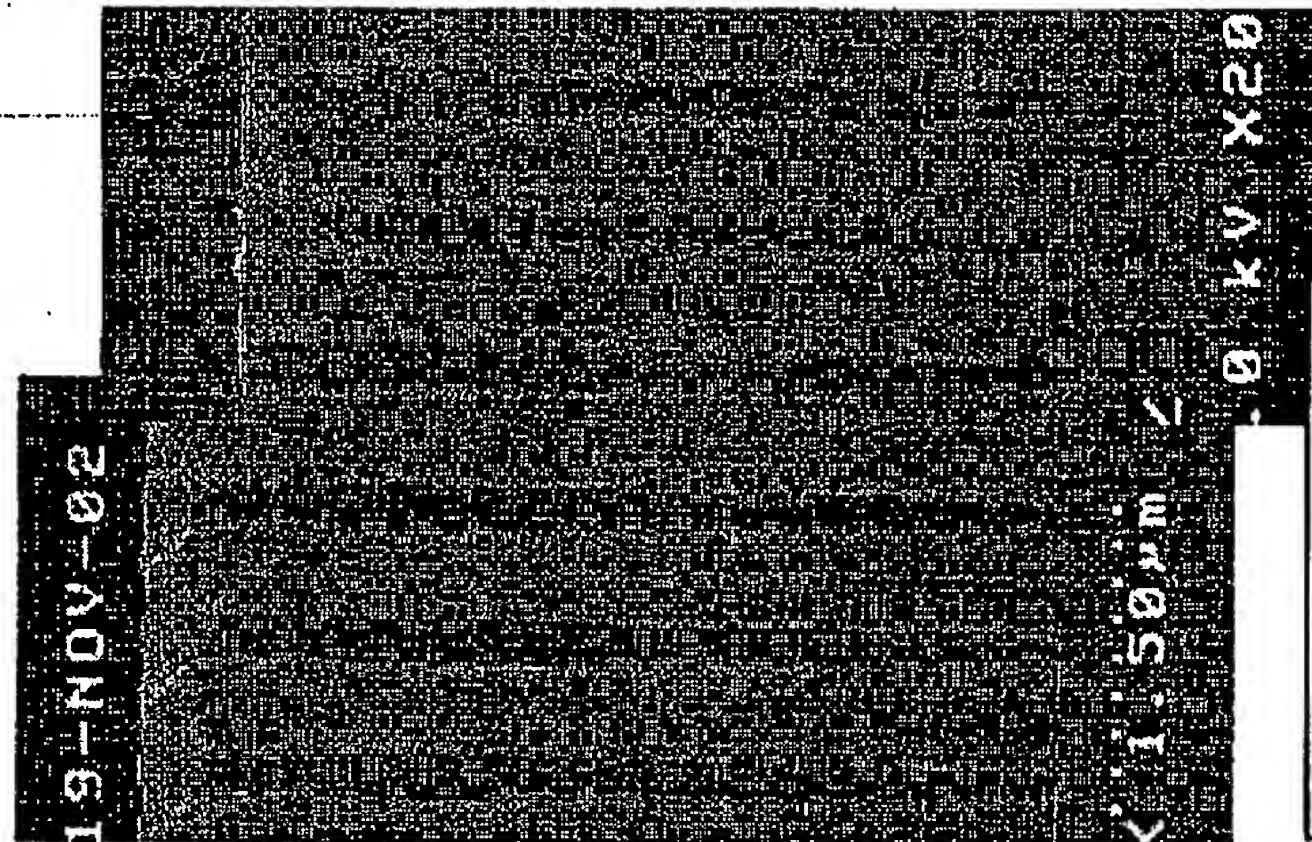
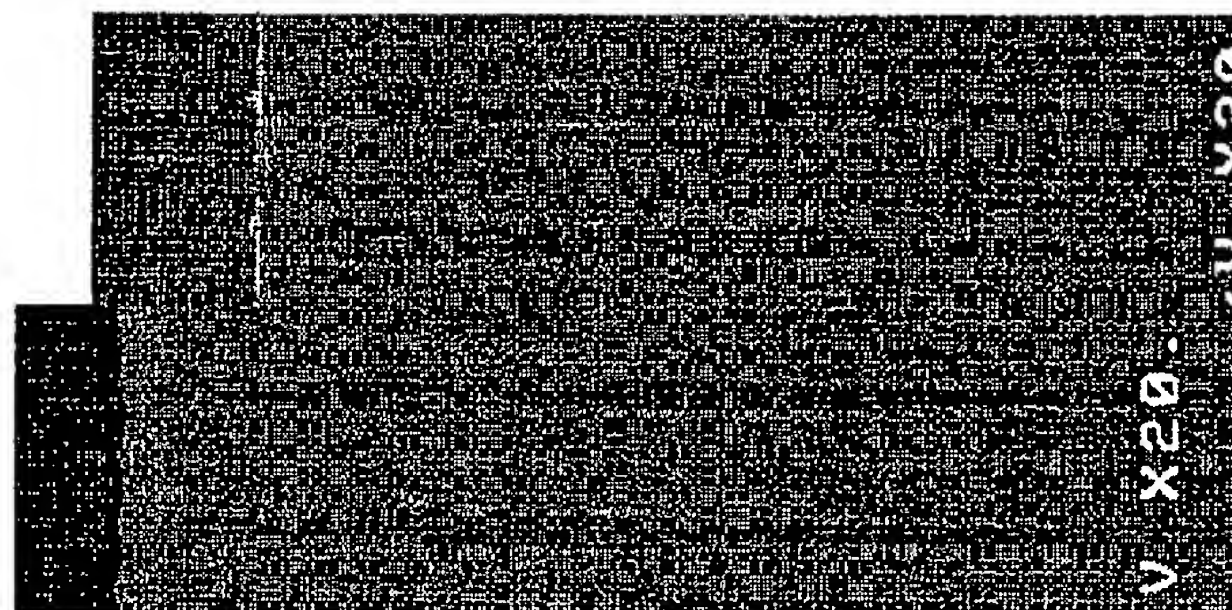
EXHIBIT 1

# Triode - Three Frequencies Test\_40 MHz UE/ 27, 2MHz LE

## Power Ratio Effect- Profile response

DFC8 Recipe

50 mT/ x1 W(40)/ x2 W(27)/ x3 W(2)/ 450 Ar/ 28 C4F8/ 10 O2/ 0 C LE/ 20 Torr He/ 20 C-High T\_UE/ 230s

900<sub>40</sub>/ 300<sub>27</sub>, 1800<sub>2</sub>600<sub>40</sub>/ 600<sub>27</sub>, 1800<sub>2</sub>300<sub>40</sub>/ 900<sub>27</sub>, 1800<sub>2</sub>

Ratio 40 MHz/ 27 MHz, 2 MHz



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EXHIBIT 2

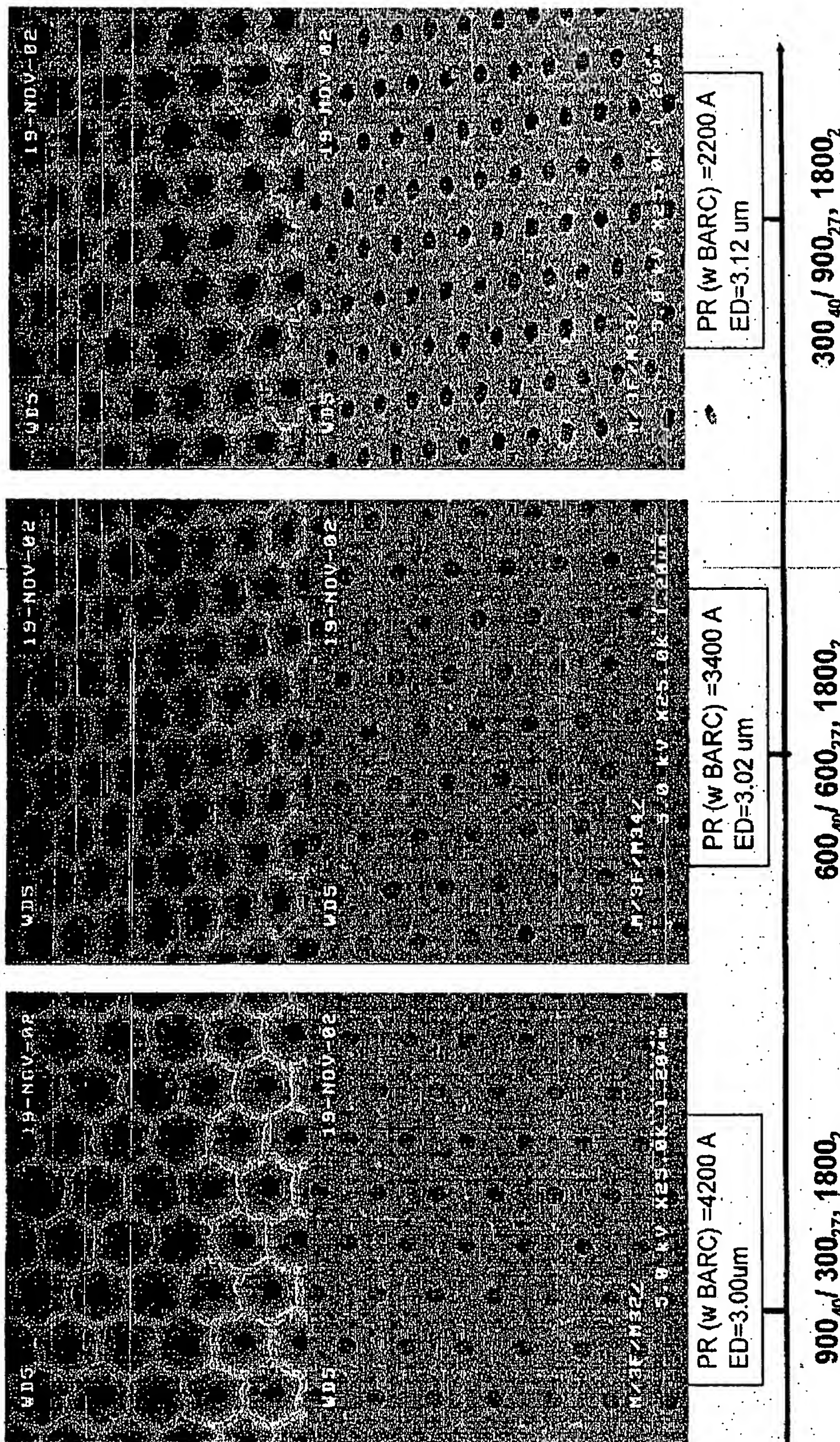


# Triode - Three Frequencies Test\_40 MHz UE/ 27, 2MHz LE

## Power Ratio Effect- Wiggling and striations

DFC8 Recipe

50 mT/ x1 W(40)/ x2 W(27)/ x3 W(2)/ 450 A/ 28 C4F8/ 10 O2/ 0 C LE/ 20 Torr Hel/ 20 C-High T\_UE/ 230s



Ratio 40 MHz/ 27 MHz, 2 MHz

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